NEW SPECIES OF UREDINEAE—XII

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New species of Uredineae—XII*

Joseph Charles Arthur

The preceding number in this series† was issued in April, 1919. Since that time the work of studying and assorting all of the remaining material in the rust herbarium, not heretofore assigned to acceptable genera and species, has proceeded with the result that a number of forms have been separated as worthy of recognition under distinctive names. These new species, founded for the most part on collections that have long reposed in various herbaria, together with two species that have been passing under erroneous names, are here established. A few species are transferred to other genera, and in three cases where the name was preoccupied new names have been given.

Melampsora americana sp. nov.

O. Pycnia hypophyllous, scattered among the aecia, broadly conic or hemispheric, yellowish or light-brown, rather inconspicuous, subcuticular but extending into and disintegrating the epidermal cells beneath, 80–150 μ broad by 50–90 μ high; ostiolar filaments wanting.

I. Aecia hypophyllous, scattered over part or all of the leaf on yellowish areas, oval or oblong, 0.3–0.8 mm. long, soon naked, pulverulent, at first orange-color, becoming pale-yellow, ruptured cuticle barely noticeable; aeciospores globoid or ellipsoid, 12–18 by 16–23 μ; wall colorless, 1.5–2.5 μ thick, closely and finely but noticeably verrucose.

II. Uredinia hypophyllous, irregularly scattered, usually on yellow spots, round, either very small, 0.1–0.2 mm. across, and pale, or large, 0.2–0.5 mm. across, pulvinate, orange fading to pale-yellow, ruptured epidermis inconspicuous; paraphyses capi-

* Reprints may be obtained by application to the Botanical Department, Purdue University Agricultural Experiment Station, Lafayette, Indiana, under whose auspices the studies here reported were largely carried out.

† New species of Uredineae I–XI: Bull. Torrey Club (I) **28**: 661–666. 1901; (II) **29**: 227–231. 1902; (III) **32**: 1–8. 1904; (IV) **33**: 27–32. 1906; (V) **33**: 513–522. 1906; (VI) **34**: 583–592. 1907; (VII) **37**: 569–580. 1910; (VIII) **38**: 369–378. 1911; (IX) **42**: 585–593. 1915; (X) **45**: 141–156. 1918; (XI) **46**: 107–125. 1919.

tate or clavate-capitate, 20–30 μ broad in upper part, 30–60 μ long, in strongly capitate forms the wall 4–5 μ thick, obliterating the lumen of the stalk, thicker at apex, 6–9 μ, in clavate forms the wall 1–2 μ thick, thicker above, 2–5 μ, colorless, smooth; urediniospores globoid or broadly ellipsoid, small, 13–16 by 15–20 μ; wall colorless, moderately thin, 1.5–2 μ, closely and finely verrucose.

III. Telia hypophyllous, scattered, irregularly roundish, 0.2–0.4 mm. across, reddish-brown, subepidermal, indehiscent, teliospores oblong or prismatic, rounded at both ends, 7–12 by 30–32 μ; wall light-brown, uniformly thin, about 1 μ, smooth.

On *Abies balsamea* (L.) Mill., Pictou, Nova Scotia, June 24, 1910, *W. P. Fraser;* Brule, Wisconsin, June-July, 1913, *E. M. Gilbert;* Fish Creek [Green Bay peninsula], Wisconsin, July 4, 1913, *J. J. Davis;* Alpena, Michigan, June 20, 1914, *C. H. Kauffman;* Walden, Vermont, July 8, 1917, *C. R. Orton.*

On *Abies concolor* Lindl. & Gord., Ouray, Colorado, July 26, 1912, *J. C. Arthur 8504* (Barth. Fungi Columb. *3819*); Palmer Lake, Colorado, July 3, 18, 1913, & July 15, 1916, *E. Bethel.*

On *Salix balsamifera* Barr., Pictou, Nova Scotia (near caeoma on *Abies*), August 27, 1910, II, III, *W. P. Fraser.*

Salix discolor Muhl., Pictou, Nova Scotia, July 17, 1910, II, November (?), 1910 III, *W. P. Fraser* (type, partly used for cultures); Orient, New York, September 7, 1914, II, September 28, 1919, II, *Roy Latham.*

Salix humilis Marsh., Orient, New York, September 19, 1915, II, III, *Roy Latham 647.*

On *Salix monticola* Bebb, Palmer Lake, Colorado, September 6, 1913, II. *E. Bethel.*

On *Salix pedicellaris* Pursh, Solon Springs, Wisconsin, August 13, 1915, II, III, *J. J. Davis.*

On *Salix Scouleriana* Barr., Libby, Montana, October 15, 1911, ii, III, *James R. Weir;* Ouray, Colorado, July 24, 1912, II, *Mrs. J. C. Arthur 4307;* Palmer Lake, Colorado, September 6, 1913, II, iii, *E. Bethel,* September 20, 1913, II, III, *Bartholomew & Bethel 5669.*

On *Salix Wrightii* And., Brazito, New Mexico, November 1, 1915, ii, III, *W. A. Archer 25.*

This is a common and abundant species, extending practically throughout the United States and southern Canada, and probably

southward through Mexico and Central America. It has heretofore passed under the name of *Melampsora arctica*. The type selected for the species is the collection on *Salix discolor* Muhl., made by W. P. Fraser at Pictou, Nova Scotia, November (?), 1910, and partly used for successful cultures in May, 1911, on *Abies balsamea*, which were reported in Mycologia (4: 187–188. July, 1912).

The first aecia of this species seen by the writer were forwarded by Professor Fraser in 1910. Word was returned that they were an undescribed form, probably belonging to *Melampsora arctica* on *Salix*. Telial material on *Salix* was secured by Professor Fraser in the fall, and sown on *Abies balsamea* in May, 1911, with abundant success (*cf.* Mycologia *l.c.*). Representative specimens were sent to the writer, and these now constitute the type material for the new species. A similar culture was made in June, 1912 (*cf.* Mycologia 5: 238. 1913).

An entirely independent set of observations and cultures was made by Mr. E. Bethel in Colorado. He obtained aecia on *Abies concolor* at Palmer Lake, Colorado, July 15, 1916, and on the following morning made sowings in his garden at Denver, on three species of willow. Eighteen days afterward, August 3, an abundance of uredinia was found on two plants, one probably *Salix Bebbiana*, and the other probably *S. Scouleriana*, but on two other equally vigorous plants of *S. amygdaloides* there was no indication of infection. Representative specimens with notes are in the Arthur herbariun.

All the aecial collections known to the writer, with the exception of one uncertain specimen from the state of Washington, are mentioned above, and most of the telial collections. But some forty collections believed to belong here, mostly with uredinia only, are not listed. The unlisted specimens include the hosts: *Salix cordata* Muhl., *S. exigua* Nutt., *S. Fendleriana* And., *S. lasiolepis* Benth., *S. lutea* Nutt., *S. Mackenziana* Barr., *S. Nelsoni* Ball, *S. sitchensis* Sans., *S. taxifolia* H. B. K., as well as the cultivated forms, *S. alba* L., *S. babylonica* L., *S. Caprea* L., and *S. purpurea* L. These collections come from the following states in addition to those mentioned above: Alaska, Arizona, California,

Idaho, Oregon, Washington, West Virginia, Virginia; Alberta, British Columbia; Guatemala.

I am indebted to Mr. Ivar Jorstad, plant pathologist to the government of Norway, for calling my attention to the misapplication of the name *Melampsora arctica*. While in this country in 1919–20 he paid two visits to Purdue University, and made most helpful suggestions regarding the synonymy and limitation of a number of species to appear soon in the North American Flora. He pointed out that no rust was known in Europe corresponding to the American caeoma on *Abies*.

Mr. Jorstad further directed attention to the essential identity of *Melampsora alpina* Juel and *M. arctica* Rostr., as given in the 7th volume of the North American Flora, pp. 99, 100, and as confirmed by his own studies. In Greenland, where Rostrup's material was obtained, various species of *Saxifraga*, on which the aecia are to be looked for, are common, while species of *Abies* are absent. In Europe *M. alpina* Juel has been cultured by means of *Saxifraga* caeoma on *Salix herbacea*, the common American host recorded for *M. arctica*. *M. arctica* is the older name, and the species to which it properly applies is a boreal form with aecia on Saxifragaceae, and entirely distinct from the more southern *M. americana* with aecia on *Abies*.

Pucciniastrum americanum (Farl.) comb. nov.

Pucciniastrum arcticum americanum Farl. Rhodora 10: 16. 1908.

This species differs from *Pucciniastrum arcticum* (Lagerh.) Tranz., with which it has been united, especially by the narrow, urceolate peridium, which is readily distinguished from the broad, low peridium of *P. arcticum*, even under a low power of the microscope. *P. arcticum* is a boreal species, chiefly known from northern Europe and Alaska. In Alaska it occurs on *Rubus stellatus* Smith and *R. Chamaemorus* L. Outside of Alaska only two American collections are known, one on *R. pubescens* Raf. (*R. triflorus* Richards.), from Grand Manan, New Brunswick, August, 1888, *K. Miyabe*, and one on *R. occidentalis* L., from Algona, Wisconsin, September, 1914, *B. O. Dodge*.

P. americanum is more southern and a much more abundant species. It ranges through the southern part of Canada from

British Columbia to Nova Scotia, and southward to Iowa and West Virginia. It is especially abundant in the northeastern United States on *Rubus strigosus* Michx., and less so on *R. occidentalis* L. It also occurs on *R. pubescens* Raf., and in the northwest on *R. melanolasius* Focke. The aecia for both *Pucciniastrum arcticum* and *P. americanum* are unknown.

Puccinia offuscata sp. nov.

II. Uredinia amphigenous, scattered, round or oval, 0.3–1 mm. long, rather tardily naked, pulverulent, dark cinnamon-brown, ruptured epidermis conspicuous; paraphyses intermixed with the spores, slightly clavate, 5–9 by 29–48 μ, the wall 1 μ thick, colorless, smooth; urediniospores broadly ellipsoid or broadly obovoid, 18–23 by 23–29 μ; wall cinnamon-brown, 1.5–2.5 μ thick, finely and closely echinulate, the pores 3 or 4, equatorial.

III. Telia hypophyllous, few, scattered, round, 0.1–0.3 mm. in diameter, rather tardily naked, compact, dark cinnamon-brown, ruptured epidermis conspicuous; teliospores clavate, 13–18 by 32–53 μ, rounded above, narrowed below, slightly constricted at septum; wall light golden-brown, 1–2 μ thick, slightly thickened at apex, 1–5 μ, smooth; pedicel up to one half length of spore, colorless.

On *Zornia bracteata* (Walt.) Gmel. (*Z. tetraphylla* Michx.), Braidentown, Florida, May 11, 1900, II, *S. M. Tracy 6583*.

On *Zornia diphylla* (L). Pers., Pinar del Rio, Cuba, April 23, 1903, II, iii, *J. A. Shafer 292;* Herradura, Cuba, September 30, 1904, II, iii, *C. F. Baker 2143* (type); same, November 26, 1917, II, *F. S. Earle 822;* Mayagüez, Porto Rico, March 7, 1916, II, *Whetzel & Olive 200;* Barcelonita, Porto Rico, April 6, 1916, II, *Whetzel & Olive 199*.

This species of rust has heretofore passed under the name of *Uredo Zorniae* or *Puccinia Zorniae*, names which properly apply to the Old World species on the same two hosts as listed above. The two species differ noticeably in both urediniospores and teliospores. The Old World species has urediniospores with two pores, or an occasional spore with three pores, and the teliospores are not so elongated, much constricted at septum, with the two cells nearly of the same size and shape, being globoid. An excellent description and an illustration from a photograph are given by McAlpine, Rusts of Australia, page 172, *pl. 10, f. 87*.

The teliospores of *P. offuscata* have been found only in the province of Pinar del Rio, Cuba. The earliest record was brought to light by Mr. Percy Wilson from a collection in the phanerogamic herbarium of the New York Botanical Garden, made by Shafer on a dry plateau, doubtless not far from Herradura. The teliospores, which have not yet been found in abundance, germinate *in situ* upon maturity. The same species occurs in the vicinity of Rio de Janeiro, Brazil (Hedwigia **38**: 257. 1899), and also in in northern Brazil (Hedwigia **43**: 161. 1904).

Puccinia senilis sp. nov.

II. Uredinia hypophyllous, scattered, 0.2–0.4 mm. in diameter, early naked, pulverulent, yellow, ruptured epidermis inconspicuous; urediniospores obovoid or broadly ellipsoid, 15–18 by 19–23 μ; wall light-yellow, 1 μ thick, sparsely echinulate, the pores very inconspicuous, apparently 3 or 4, equatorial.

III. Telia amphigenous, scattered, round, 0.1–0.3 mm. in diameter, early naked, pulverulent, chocolate-brown, ruptured epidermis inconspicuous; teliospores ellipsoid, 18–24 by 27–40 μ, rounded at both ends, somewhat constructed at septum; wall dark chestnut-brown, 1.5–2.5 μ thick, 5–7 μ over the germ-pores, often with a semihyaline cap over apex, coarsely and moderately verrucose; pedicel colorless, up to 50 μ long, tapering downward and roughened below, fragile.

On *Lippia myriocephala* Cham. & Schlecht., Laguna on Lake Amatitlan, Guatemala, January 20, 1906, II, III, *W. A. Kellerman 5451*. Only the one collection is known, of which the corresponding host collection, numbered 5209, was determined by John Donnell Smith. The material is not abundant but the rust appears distinct and unequivocal. If the wall of the teliospores were more evidently laminated, there could be no hesitancy in placing it under the genus *Prospodium*, although pycnia have not been detected. The species seems closely related to *Puccinia peruviana* Sydow, from western South America on *Lippia urticoides*.

Puccinia gulosa H. S. Jackson, sp. nov.

III. Telia caulicolous and petiolicolous, oval or elliptic, gregarious, frequently confluent along somewhat swollen stems and petioles for 1–2 cm., early naked, cinnamon-brown, pulverulent, ruptured epidermis noticeable; teliospores ellipsoid or oblong,

15–18 by 26–35 μ, rounded above and below, strongly constricted at septum; wall cinnamon-brown, 1.5–2 μ thick, with a small subhyaline umbo over the pore of the upper cell, 2.5–3 μ, finely but noticeably verrucose-rugose, best seen when dry; pedicel colorless, short, fragile, largely disappearing.

On *Polemonium pulcherrimum* Hook., Colby Mountains, above Muir Gorge, Yosemite National Park, California, 8500 feet altitude, August 6, 1919, *Mrs. Mary Strong Clemens 24*.

This species appears to be a short-cycle form, although no pycnia or germinating teliospores were found. It is similar to *P. Polemonii* Diet. & Holw., which is known by the type collection from Idaho, 1892, and one collection from southern Indiana, 1919. That species, however, has narrower, smooth spores, with a decidedly thickened apex, 4–6 μ. The sori of the latter are compact, and show abundant germination, while the sori of the new species are pulverulent, and show no germinating spores.

Puccinia proximella (Arth.) comb. nov.

Uredo proximella Arth. Mycologia 7: 324. 1915.

Recently in studying this West Indian rust Dr. E. B. Mains discovered teliospores on the type collection made at Sabana Grande, Porto Rico, March 30, 1913, *F. L. Stevens 318*, and has drawn up the following description:

III. Telia hypophyllous, scattered, rather tardily naked, ruptured epidermis conspicuous; teliospores ellipsoid or oblong, 21–27 by 26–42 μ, rounded above and below, slightly constricted at septum; wall dark chestnut-brown, uniformly thick, 1.5–2 μ, moderately and distinctly verrucose; pedicel colorless.

Puccinia hiascens nom. nov.

Puccinia aucta Arth. & Holway; Arth. Am. Jour. Bot. 5: 475. 1918. Not *P. aucta* Berk. & Müll. 1872.

The recent discovery that the name applied to this Guatemalan rust on *Saurauja* had previously been used for a very different Australian rust necessitates a change in the name.

Puccinia Heterisiae H. S. Jackson, nom. nov.

Puccinia aspera Diet. & Holway; Arth. Bull. Torrey Club 29: 230. 1902. Not *P. aspera* Bon. 1869.

Dasyspora aspera Arth. Résult. Sci. Congr. Bot. Vienne 346. 1906.

Professor Jackson, who has been working upon the group to which this rust belongs, has suggested a change of the name, as the one under which it is now known he finds to be preoccupied. The rust is on *Heterisia Mertensiana* (Bong.) Small (*Saxifraga Mertensiana* Bong., *S. heterantha* Hook.), and beside the type collection from Mt. Adams (Mt. Paddo), Washington, at about 2000 meters altitude, is now known by an ample collection from the vicinity of Grinnell glacier, 1650–1950 meters altitude, Glacier National Park, Montana, July 31, 1919, *Paul C. Standley 16814*.

Uromyces imperfectus nom. nov.

Uredo Bauhiniae Berk. & Curt. Proc. Am. Acad. 4: 126. 1860.
Uromyces Bauhiniae Vesterg. Ark. Bot. Stockh. 4^{15}: 21. 1905.
Not *U. Bauhiniae* P. Henn. 1895.

As the specific name for this species is preoccupied, a new name becomes necessary. Only two collections have been seen by the writer, one being the type collection from Nicaragua, and the other from Moneague, Jamaica, February 24, 1915, *E. W. D. Holway 231*, both showing only uredinia.

Uredo contraria sp. nov.

II. Uredinia hypophyllous, scattered, round, minute, 0.1–0.3 mm. in diameter, early naked, yellow, very pulverulent, ruptured epidermis inconspicuous; urediniospores oblong or obovate-oblong, 20–24 by 27–35 μ; wall colorless, 1.5–2 μ thick, finely and rather sparsely echinulate, the pores obscure.

On *Phacelia tanacetifolia* Benth., Carmel, California, April 15, 1919, *E. W. D. Holway*, July 4, and October 1, 1919, *Mrs. Joseph Clemens*.

This rust, in its gross appearance and even in the microscopic appearance of its spores, resembles species of *Pucciniastrum*, but careful sectioning of the sori shows them to be applanate, and without peridium or paraphyses. The spores are produced in abundance, and due to their bright yellow contents, make a considerable showing of yellow powder on the under side of the leaves. The species occurs among the sand dunes where *Pinus radiata* grows, and along the dusty roadsides of the region. It was watched

for a number of months by Professor Holway, and from January to October by Mrs. Clemens, but no other stage of development could be detected.

Uredo nitidula sp. nov.

II. Uredinia amphigenous, scattered, roundish or oblong, 0.3–0.7 mm. across, rather tardily naked, pulverulent, dark cinnamon-brown, ruptured epidermis conspicuous; urediniospores obovoid or ellipsoid, 18–24 by 24–29 μ; wall cinnamon-brown, 1.5–2 μ thick, moderately echinulate, the pores 2 or 3, equatorial.

On *Alternanthera philoxeroides* Griseb., Cahabon, Guatemala, October 27, 1877, *Von Türckheim*.

This collection is represented by a specimen in the cryptogamic herbarium of the New York Botanical Garden, where it is labelled "*Uredo? paranensis* Penningt." It is, however, noticeably different from the species indicated in having smaller spores with thinner walls.

Uredo laeticolor nom. nov.

Uredo Operculinae Arth. Mycologia **9**: 95. 1917. Not *U. Operculinae* Sydow, Phil. Jour. Sci. **8**: 476. 1913.

My attention has been called to the earlier use of the name which I gave to this convolulaceous rust from the West Indies. The name was used by the Sydows for a Philippine rust on *Operculina turpethum*, which appears from the description to have somewhat smaller and thicker walled spores, more inclined to be globoid, and paler in color.

Aecidium Ixorae sp. nov.

O. Pycnia epiphyllous, scattered unevenly over large discolored areas often 4–8 cm. across, punctiform, prominent, dark-brown, becoming whitish by age, subepidermal, flattened hemispherical, 150–200 μ in diameter, about half as high, with a flat hymenium; ostiolar filaments wanting.

I. Aecia hypophyllous, opposite the pycnia, scattered, deep-seated, cylindric, 0.2–0.3 mm. across; peridium colorless, the margin strongly recurved, lacerate; peridial cells rhombohedric, strongly imbricate, the exposed inner face about 16–19 μ across, in section much prolonged downward on outer side, the inner wall about 3 μ thick, verrucose, the outer wall about 2 μ thick, smooth; aeciospores globoid, small, 16–19 μ in diameter; wall colorless, 1 μ or less thick, finely verrucose, appearing smooth.

On *Ixora ferrea* (Jacq.) Benth. (*Siderodendron triflorum* Vahl), Bahia Honda, Cuba, October 28, 1919, *S. C. Bruner 1133*.

A very distinctive form, and especially remarkable in having hemispherical pycnia with flat hymenia, that are beneath the firm epidermis, opening at first by a minute central pore to discharge the pycniospores, and in all characters similar to pycnia heretofore known only as subcuticular. The large areas over which the original infection seems to spread, producing a brown, deadened appearance on both surfaces of the thick, leathery leaves, make the species an easy one to detect in the field. Mr. Bruner writes that the type locality is in a rather inaccessible district in the mountains, some six miles from the village of Bahia Honad.

Aecidium indecisum sp. nov.

O. Pycnia hypophyllous, scattered over all or large areas of the leaves among the aecia, conspicuous, honey-yellow, subepidermal, in section globoid, 80–110 μ in diameter; ostiolar filaments long.

I. Aecia hypophyllous, scattered from a diffused mycelium, cupulate, 0.3–0.5 mm. in diameter, projecting but slightly above the host tissue; peridium remaining somewhat incurved and covered by the host tissues, the margin erose; peridial cells in section oblong or rhomboidal, 16–26 by 30–40 μ, abutted, or slightly overlapping, the outer wall thick, 8–10 μ, transversely striate, smooth, the inner wall thinner, 3–6 μ, closely and rather finely verrucose; aeciospores ellipsoid or globoid, 16–19 by 21–26 μ; wall colorless, thin, 1–1.5 μ, closely and inconspicuously verrucose.

On *Ranunculus californicus* Benth., Berkeley, California, March 11, 1893 (Sydow, Ured. *900;* Barth. N. Am. Ured. *1303*), *W. C. Blasdale.*

This appears much like *Aecidium Ranunculi* Schw., the name under which it has been distributed, but differs in its much more robust development, the measurements in every way being greater. *A. Ranunculi* Schw. is known to be the aecial form of *Puccinia Eatoniae* Arth. on species of *Sphenopholis*. Both this rust and its telial host are only known from east of the Rocky Mountains. It may be assumed that the California aecia are heteroecious, and belong to some inconspicuous and rather evanescent grass rust, probably not yet reported.

There has probably been but one collection of this form made, although dates on the different packets in herbaria are not uniform. The date on the Sydow distribution is "31.5.1894," but a packet in the herbarium of the New York Botanical Garden, reads "March 31, 1894," so I assume that "5" is a misreading of "3." The Bartholomew distribution gives March 11, 1893. This material was received through Professor E. W. D. Holway, who obtained it from the collector. Possibly there were two collections made in consecutive years, but the appearance of the material does not warrant the assumption. I am using the material distributed by Bartholomew as the type.

Aecidium Mitellae Ellis & Ev., sp. nov.

O. Pycnia not seen.

I. Aecia hypophyllous, in crowded circular groups 2–3 mm. across; peridia cupulate, small; aeciospores globoid, or broadly ellipsoid, 15–18 by 18–26 μ; wall thin, 1 μ, colorless, minutely verrucose.

On *Mitella nuda* L., Shoal Point, Bay of Islands, Newfoundland, *Waghorne*.

The specimen from which this description is drawn is in the cryptogamic herbarium of the New York Botanical Garden, and consists of a single leaf bearing three groups of aecia. The specimen appears to have been sent to Mr. J. B. Ellis by Waghorne, although the collector's name is not written on the packet. The packet bears the doubtful date of "13.7.82," which possibly indicates that the material was secured on July 13, 1882. A note accompanies the specimen, reading, "This seems to be on various leaves and stems of this *Mitella;* I have only one leaf more." Whether this was written by Mr. Waghorne or Mr. Ellis is uncertain. There seems to be no doubt about the identity of the host, or the genuineness of the rust, so that the name given by Mr. Ellis and apparently not heretofore published, should be established. The form appears to be a heteroecious one.

Aecidium subsimulans Arthur & Mains, sp. nov.

O. Pycnia amphigenous, on brownish or reddish spots 2–5 mm. across, noticeable, cinnamon-brown, subepidermal, flattened-

globoid, 95–125 μ broad by 60–95 μ high; ostiolar filaments up to 125 μ long.

I. Aecia hypophyllous, crowded in spots with the pycnia, cylindric, 0.2–0.3 mm. wide, 0.5–1 mm. high; peridium white, the margin somewhat erect, erose; peridial cells rhomboidal, 19–26 by 32–45 μ, somewhat overlapping, the outer wall thick, 9–13 μ, transversely striate, smooth, the inner wall 4–6 μ thick, closely and rather coarsely verrucose; aeciospores globoid or ellipsoid, 19–23 by 23–29 μ; wall colorless, 1.5–2.5 μ thick, very closely and finely verrucose.

On *Salvia candicans* Mart. & Gall., hills about Tehuacan, State of Puebla, Mexico, 1895, *C. G. Pringle.*

On *Salvia Lemmoni* A. Gray, Carr Peak, Huachuca Mountains, Arizona, August 25, 1910, *L. N. Goodding 856* (type).

On *Salvia* sp., Sierra de Pachuca, State of Hidalgo, Mexico, July 20, 1905, *Rose, Painter & Rose 8792.*

This species somewhat resembles the aecia of *Puccinia caulicola* Tr. & Gall., as well as the Mexican *Aecidium zonatum* Sacc., but the walls both of the spores and of the peridial cells are much thicker. Dr. Mains, who has made a special study of the *Salvia* rusts, has joined me in deciding upon the status of this species.

Aecidium Betheli sp. nov.

O. Pycnia not seen.

I. Aecia hypophyllous, subepidermal, in small and crowded groups 1–3 mm. across, on a hemispherical, hypertrophied substratum, cupulate, small, 0.1–0.2 mm. in diameter; peridium low, erect, the margin erose; peridial cells readily falling apart, rhomboidal, 13–18 by 19–23 μ, strongly overlapping, the outer wall 7–9 μ thick, transversely striate, smooth, the inner wall 1 μ, evenly and noticeably verrucose; aeciospores globoid, small, 13–18 by 16–18 μ; wall colorless, thin, 1 μ or less, very finely and evenly verrucose.

On *Jussiaea californica* (S. Wats.) Jepson, Long Beach, California, August 15, 1916 (type), August 24, 1918, *E. Bethel.*

Found in abundance associated with *Puccinia canaliculata* (Schw.) Lagerh., on *Cyperus esculentus*, but probably not genetically connected, as neither the relationship of the host nor the structure of the aecia agrees with those of the known aecial stage for that species. The species is dedicated to the discoverer, who

is one of the most active and resourceful observers of the Uredinales among American botanists, and who has explored the Rocky Mountain and Pacific coast rust flora with unparalleled thoroughness.

Aecidium arctoum sp. nov.

O. Pycnia epiphyllous and to a less extent hypophyllous among the aecia, numerous, rather inconspicuous, small, subepidermal, in section globoid, 128–160 μ in diameter; ostiolar filaments prominent, up to 80 μ long.

I. Aecia hypophyllous, subepidermal, diffused on slightly paler spots 3–7 mm. across, cupulate, very small, 0.1–0.2 mm. in diameter; peridium delicate, erect or somewhat recurved, the margin erose or fimbriate; peridial cells rhomboidal, 16–19 by 28–32 μ, somewhat overlapping, the outer wall 1–1.5 μ thick, smooth, the inner wall 3–6 μ thick, moderately verrucose; aeciospores globoid, or some of them oblong, 21–26 by 23–29 μ; wall colorless, thin, 1–1.5 μ, minutely verrucose.

On *Elaeagnus angustifolia* L., Kulm, North Dakota, June 24, 1919, *J. F. Brenckle 1235*.

The form described here as a new species was found in considerable abundance on a hedge of the Eurasian oleaster in the town of Kulm. Dr. Brenckle, who submits the material, could find no rusted grass or sedge in the vicinity that seemed at all likely to serve as the alternate host, although it is undoubtedly a heteroecious species. The supposition that the rust could have been imported with the hedge plants can be dismissed as highly improbable, even aside from the fact that no aecial form on this group of hosts is known in the region where the host is native.

The spores are very much smaller than those of *Aecidium Allenii* Clint., on *Elaeagnus argentea* from North Dakota, as well as those of *A. Elaeagni* Diet. and *A. minoense* Sydow from Japan. There is a Japanese form on *Elaeagnus glabra* with spores of nearly the same size, but it has larger and firmer aecia, and other characteristics which distinguish it. In spite of the appearance of this form on an exotic shrub under conditions of cultivation, it seems most likely to be a native rust that has found a congenial host in this foreign plant.

Aecidium renatum sp. nov.

O. Pycnia epiphyllous, inconspicuous, subepidermal.

I. Aecia hypophyllous, subepidermal, thickly covering the surface of the leaf, short cylindric, 0.2–0.4 mm. in diameter; peridium erect, erose; peridial cells rhomboidal, 16–19 by 26–32 μ, strongly overlapping, the outer wall 3–5 μ thick, smooth, the inner wall 6–9 μ, prominently verrucose; aeciospores globoid, 19–23 by 21–24 μ; wall colorless, thin, 1 μ, closely and finely verrucose.

On *Polygala longa* Blake, Organ Mountains, New Mexico, August 29, 1894, *E. O. Wooton.*

This is a species similar in character and appearance to *Aecidium polygalinum* Peck on *Polygala Senega* from the northern United States, but has a more vigorous development, with larger aecia and aeciospores.

Aecidium arcularium sp. nov.

O. Pycnia epiphyllous, gregarious, minutely punctiform, inconspicuous, subepidermal, in section globoid or depressed-globoid, 100–130 μ broad by 90–100 μ high; ostiolar filaments up to 45 μ long.

I. Aecia hypophyllous and caulicolous, usually densely crowded in groups 4–10 mm. across; peridium cylindric, the margin erect, erose or deeply lacerate; peridial cells ellipsoid or oblong, angular, 21–29 by 27–40 μ, the cells overlapping, the outer wall 5–10 μ thick, transversely striate, smooth, the inner wall 2–5 μ thick, finely verrucose; aeciospores globoid or ellipsoid, 18–23 by 22–29 μ; wall colorless or pale cinnamon-brown, 1–1.5 μ thick, finely verrucose.

On *Coleosanthus grandiflorus* (Hook.) Kuntze (*Brickellia grandiflora* Nutt.), Beulah, New Mexico, 1889, *T. D. A. Cockerell;* Cloudcroft, New Mexico, September 16, 1903, *E. W. D. Holway;* Upper Miller Canyon, Huachuca Mountains, Arizona, August 14, 1909, Boulder Canyon, Colorado, August, 1914, *E. Bethel;* Ute Park, Colfax County, New Mexico, August 20, 1916, *Paul C. Standley 13383;* Grousemont, Platte Canyon, Colorado, July, 1918, *Mrs. Emily Arthur* (type); Idaho Springs, Colorado, August 7, 1919, *J. M. Bates 6987.*

A conspicuous species, usually occurring in abundance within limited area. It is sometimes associated with uredinia or telia of *Puccinia subdecora* Syd. & Holw., which for a time was supposed to be genetically connected with it. No suggestion has yet been made regarding the alternate stages.

Aecidium Liabi sp. nov.

O. Pycnia epiphyllous, somewhat loosely grouped on discolored areas, inconspicuous, dark-brown, subepidermal, ellipsoid, about 95 by 128 μ; ostiolar filaments short, about 45 μ.

I. Aecia hypophyllous, in groups up to 8 mm. in diameter, cupulate, 0.3–0.8 mm. in diameter; peridium pale-yellow, fragile; peridial cells rhomboidal, 19–23 by 35–55 μ, considerably overlapping, the outer wall 2–5 μ thick, smooth, the inner wall thicker, 5–7 μ, closely tuberculate-verrucose; aeciospores angularly globoid, 21–26 by 26–31 μ; wall colorless, 1.5–2.5 μ thick, closely and distinctly verrucose.

On *Liabum* sp., Jalapa, State of Veracruz, Mexico, September 2–4, 1910, *A. S. Hitchcock*.

Aecidium Batesii sp. nov.

O. Pycnia mostly epiphyllous, in groups 1–3 mm. in diameter, noticeable, subepidermal, chestnut- or chocolate-brown, flattened-globoid, 125–160 μ broad by 90–115 μ high; ostiolar filaments up to 95 μ long.

I. Aecia amphigenous, loosely grouped upon brownish spots 4–8 mm. across, cupulate, 0.5–0.8 mm. in diameter; peridium yellowish, the margin remaining for a time incurved, covered more or less by the epidermis, finally becoming recurved, lacerate; peridial cells oblong, 15–19 by 32–35 μ, slightly overlapping or abutted, the outer wall rather thick, 6–10 μ, transversely striate, smooth, the inner wall thinner, 3–4 μ, closely and finely verrucose; aeciospores angularly globoid, 19–23 by 24–27 μ; wall colorless, 1–1.5 μ thick, very closely and finely verrucose.

On *Rudbeckia hirta* L., Callaway, Nebraska, May 31, 1901, *J. M. Bates 1814½*.

This rust has something the appearance of the aecia of *Puccinia Stipae*, having large spores, in peridia that are partly covered for a time by the epidermis. It is named in honor of its discoverer, who has for many years been indefatigable in making the rust flora of Nebraska known, and whose field observations and collections from all parts of the state have been freely placed at the service of students of the Uredinales.

Aecidium Mesadeniae sp. nov.

O. Pycnia epiphyllous, few, crowded in small groups, 1–2 mm. across, inconspicuous, dark-brown, subepidermal, flattened-glo-

boid, 95–125 μ broad by 50–65 μ high; ostiolar filaments up to 40 μ long.

I. Aecia usually hypophyllous, crowded in groups 2–6 mm. across, cupulate, small, 0.1–0.3 mm. in diameter; peridium pale-yellow, the margin recurved, lacerate; peridial cells rhomboidal, 14–18 by 24–29 μ, overlapping, the outer wall 7–9 μ thick, transversely striate, smooth, the inner wall 2–3 μ thick, closely and rather finely verrucose; aeciospores globoid or ellipsoid, small, 12–16 by 15–19 μ; wall colorless, thin, 1 μ or less, closely and finely verrucose.

On *Mesadenia atriplicifolia* (L.) Raf. (*Cacalia atriplicifolia* L.), Manhattan, Kansas, May, 1886, *W. A. Kellerman* (Rab.-Wint.-Paz. Fungi Eur. *3833a*), same, June, 1886 (Ellis & Ev. N. Am. Fungi *1811*), Valley Park, Missouri, May, 1887 (*L. H. Pammel?*).

On *Mesadenia reniformis* (Muhl.) Raf. (*Cacalia reniformis* Muhl.), Somers, Wisconsin, June 3, 1894, *J. J. Davis* (type).

The type collection of this species was found in abundance in a small area where *Uromyces minimus* Davis, on *Muhlenbergia sylvatica*, also occurred, and at the time was thought might be its aecial stage (Bot. Gaz. **19**: 415. 1894; Bull. Lab. Nat. Hist. Univ. Iowa **5**: 315. 1902). That assumption has not been disproven but seems less probable now than at first.

Aecidium praecipuum sp. nov.

O. Pycnia amphigenous, in small groups about 2 mm. across, noticeable, pale-yellow becoming dark-brown, subepidermal, flattened-globoid, 110–130 μ broad by 80–95 μ high; ostiolar filaments up to 60 μ long.

I. Aecia hypophyllous, crowded on spots 2–10 mm. across, short cylindric, 0.3–0.5 mm. in diameter; peridium pale-yellow, the margin erect, erose; peridial cells irregularly oblong, 20–23 by 32–40 μ, considerably overlapping by a long projection of the outer wall, the outer wall thick, 9–11 μ, the inner wall thinner, 4–4.5 μ, closely and noticeably verrucose; aeciospores angularly globoid or ellipsoid, 16–19 by 19–26 μ; wall colorless, thick, 2.5–3.5 μ, very closely and inconspicuously verrucose.

On *Senecio praecox* DC., Mt. Montezuma, Sierra de Guadelupe, State of Mexico, Mexico, July 8, 1905, *Rose, Painter & Rose 8028;* Sierre de Pachuca, State of Hidalgo, Mexico, July 20, 1905, *Rose, Painter & Rose 8791* (type).

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